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The Evaluation of Fatigue Caused by Plane-Bending Stress on Stainless Steel Using the Stacked-Coil Type Magnetic Sensor

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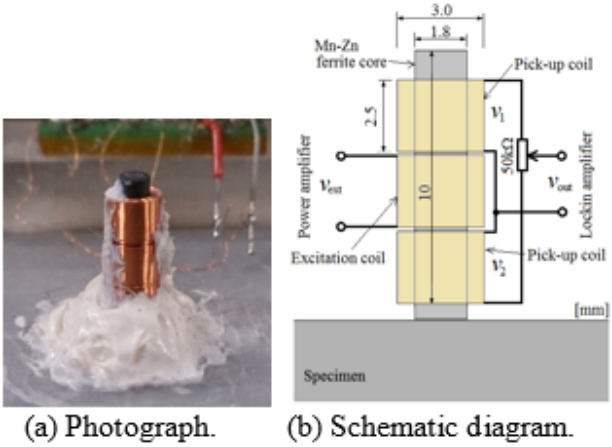
To prevent an accident due to the metal degradation of stainless steels, we have previously proposed fatigue evaluation methods (such as the remnant magnetization method using a thin-film flux-gate magnetic sensor [1] and the inductance method using a pan-cake type coil [2]). These two fatigue evaluation methods demonstrated a good correlation between the magnetic sensor output signal and the amount of plane-bending fatigue damage in stainless steels. We developed a stacked-coil type magnetic sensor shown in Fig. 1(a) in order to achieve a magnetic sensor for an accurate fatigue evaluation. This magnetic sensor was composed of two detection coils that are connected differentially, an excitation coil, and a ferrite core. Fig. 1(b) shows the connection of the excitation coil and the two detection coils. Fig. 2 shows the detection result of fatigue and crack using this magnetic sensor. The material used for this specimen was an austenitic stainless steel (SUS304), and plane-bending stress was applied. From Fig. 2, it can be seen that this magnetic sensor detected defects well. The evaluation results of plane-bending fatigue damage distribution will be shown in in detail the complete paper.



(a) Photograph. (b) Schematic diagram.

Figure 1. The stacked-coil type magnetic Sensor with a Mn-Zn Ferrite core.

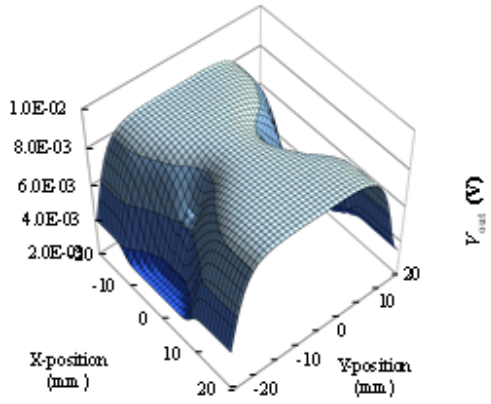


Figure 2. The distribution of of V_{out}(σ_a=300MPa, N=55000, f_{ex}=10kHz, I_{ex}=5mA).

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References:

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